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NATIONAL EUTROPHICATION SURVEY

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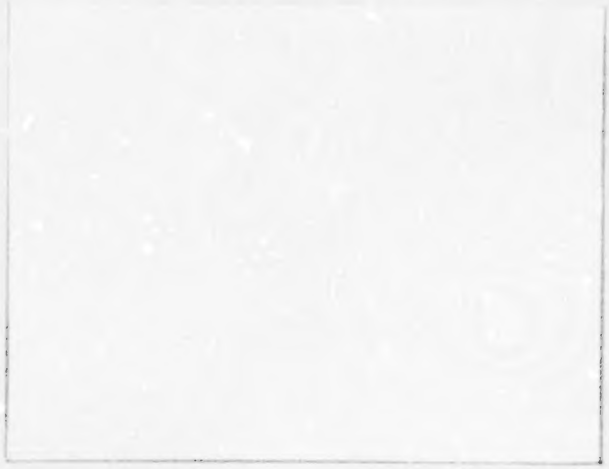

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16. ABSTRACT Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.		

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REPORT
ON
SPRUCE RUN RESERVOIR
HUNTERDON COUNTY
NEW JERSEY
EPA REGION II
WORKING PAPER No. 374

WITH THE COOPERATION OF THE
NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
AND THE
NEW JERSEY NATIONAL GUARD
MAY 1976

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point source discharge reduction and nonpoint source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's freshwater lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by the U.S. Environmental Protection Agency and to augment plans implementation by the states.

ACKNOWLEDGMENTS

The staff of the National Eutrophication Survey (Office of Research and Development, U.S. Environmental Protection Agency) expresses sincere appreciation to the New Jersey Department of Environmental Protection for professional involvement and to the New Jersey National Guard for conducting the tributary sampling phase of the Survey.

Douglas Clark, Chief of the Bureau of Water Quality Planning and Management, Mr. Frank Takacs, New Jersey National Eutrophication Survey Coordinator, Principal Environmental Specialist, and Robert Kotch, Senior Environmental Engineer, provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

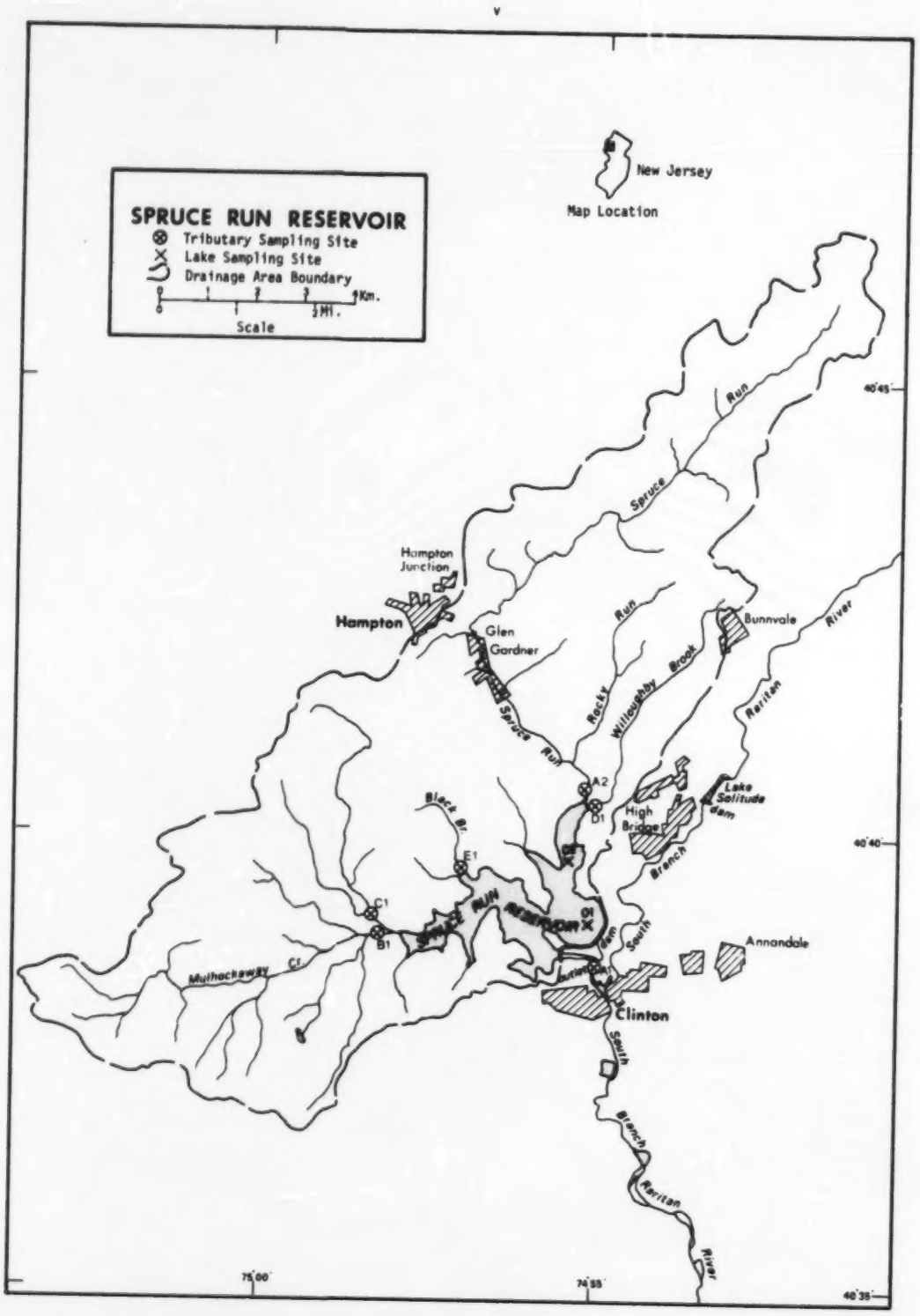
Major General William R. Sharp, Former Chief of Staff, Major General Wilfred G. Menard, Jr., Chief of Staff, and Project Officer Colonel Herbert D. Ruhlin, who directed the volunteer efforts of the New Jersey National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF NEW JERSEY

LAKE NAME	COUNTY
Budd Lake	Morris
Duhernal Lake	Middlesex
Farrington Lake	Middlesex
Greenwood Lake	Passaic, N.J.; Orange, N.Y.
Lake Hopatcong	Morris, Sussex
Lake Musconetcong	Morris, Sussex
Oradell Reservoir	Bergen
Paulinskill Lake	Sussex
Pinecliff Lake	Passaic
Pompton Lakes	Passaic
Spruce Run Reservoir	Hunterdon
Union Lake	Cumberland
Wanaque Reservoir	Passaic


SPRUCE RUN RESERVOIR
Tributary Sampling Site
Lake Sampling Site
Drainage Area Boundary
Km.
MI.
Scale
New Jersey
Map Location
Hampton Junction
Hampton
Glen Gardner
Spruce Run
Rocky Brook
Willoughby Brook
Bunnvale
River
Raritan
Lake Solitude dam
High Bridge
Branch
South
Annandale
Clinton
Black Br.
SPRUCE RUN RESERVOIR
Dam
Mulhockaway
Raritan River
A2
D1
E1
C1
B1
C2
40°45'
40°40'
40°35'
75°00'
74°55'

SPRUCE RUN RESERVOIR, NEW JERSEY

STORET NO. 3420

I. CONCLUSIONS

A. Trophic Condition:

Based upon Survey data and field observations, Spruce Run Reservoir is considered eutrophic. The lake is characterized by high nutrient concentrations, seasonal algal blooms, and dissolved oxygen depression with hydrogen sulfide formation in the summer and fall. Chlorophyll a values ranged from 9.6 µg/l in the fall to a high of 23.6 µg/l in the summer, and mean Secchi disc visibility was 181.2 cm.

B. Rate-Limiting Nutrient:

Algal assay results indicate that Spruce Run Reservoir was limited by available phosphorus. Spikes with phosphorus, or phosphorus and nitrogen simultaneously resulted in increased assay yields. Spikes with nitrogen alone did not stimulate a growth response. The mean total inorganic nitrogen to mean orthophosphorus ratio (N/P) in the spring lake data further indicates these results.

C. Nutrient Controllability:

1. Point Sources -

Point sources contributed 2.7% of the total phosphorus loading to Spruce Run Reservoir. The loading of 0.28 $g/m^2/yr$ is less than the "permissible" loading proposed by Vollenweider (Vollenweider and Dillon, 1974). Total elimination of known point sources will not lower the loading from its present level.

2. Nonpoint Sources -

The total phosphorus load from nonpoint sources accounted for 97.3% of the load reaching Spruce Run Reservoir. Major tributaries contributed 78.0% while minor tributaries and immediate drainage areas contributed 13.1% of the load.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS

Lake and drainage basin characteristics are itemized below. The lake surface area and mean depth were provided by the State of New Jersey. Tributary flow data were provided by the New Jersey District Office of the U.S. Geological Survey (USGS). Outlet drainage area includes the lake surface area. Mean hydraulic retention time was obtained by dividing the lake volume by the mean flow of the outlet. Precipitation values are estimated by methods as outlined in National Eutrophication Survey (NES) Working Paper No. 175. A table of metric/English conversions is included as Appendix A.

A. Lake Morphometry:

1. Surface area: 5.22 km^2.
2. Mean depth: 7.9 meters.
3. Maximum depth: 22.2 meters.
4. Volume: 41.238 x 10^6 m^3.
5. Mean hydraulic retention time: 296 days.

B. Tributary and Outlet (see Appendix B for flow data):

1. Tributaries -

Name	Drainage area(km^2)	Mean flow (m^3/sec)
A(2) Spruce Run	40.1	0.57
B(1) Mulhockaway Stream	30.6	0.42
C(1) Unnamed Stream	7.1	0.11
D(1) Willoughby Brook	6.3	0.09
E(1) Black Brook	4.5	0.07
Minor tributaries and immediate drainage -	13.1	0.26
Totals	101.7	1.52

2. Outlet - A(1) Spruce Run 107.0 1.61

C. Precipitation:

1. Year of sampling: 154.1 cm.

2. Mean annual: 120.6 cm.

III. LAKE WATER QUALITY SUMMARY

Spruce Run Reservoir was sampled three times during the open-water season of 1973 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from two stations on the lake and from one or more depths at each station (see map, page v). During each visit, depth-integrated samples were collected from each station for chlorophyll a analysis and phytoplankton identification and enumeration. During the first visit, an 18.9-liter depth-integrated sample was composited for algal assays. Maximum depths sampled were 19.8 meters at Station 1 and 10.4 meters at Station 2. For a more detailed explanation of NES methods, see NES Working Paper No. 175.

The results obtained are presented in full in Appendix C and are summarized in III A for waters at the surface and at the maximum depth for each site. Results of the phytoplankton counts and chlorophyll a determinations are included in III B. Results of the limiting nutrient study are presented in III C.

SPRUCE RUN RESERVOIR
STORET CODE 3420

PHYSICAL AND CHEMICAL CHARACTERISTICS

PARAMETER	(4/18/73) S*** = 2 N*	RANGE	MEDIAN	MAX DEPTH RANGE (METERS)	(7/22/73) S*** = 2 N*	RANGE	MEDIAN	MAX DEPTH RANGE (METERS)	(10/ 2/73) S*** = 2 N*	RANGE	MEDIAN	MAX DEPTH RANGE (METERS)
TEMPERATURE (DEG CENT)												
0.-1.5 M DEPTH	2	10.8- 11.9	11.3	0.0- 0.0	4	25.8- 27.3	26.5	0.0- 1.5	4	19.8- 20.3	20.0	0.0- 1.5
MAX DEPTH**	2	8.9- 9.5	9.2	9.8- 13.1	2	11.5- 13.6	12.5	10.1- 19.8	2	12.9- 14.5	13.7	10.4- 12.2
DISSOLVED OXYGEN (MG/L)												
0.-1.5 M DEPTH	0	*****-*****	*****	*****-*****	2	9.0- 9.1	9.0	0.0- 0.0	2	8.2- 8.8	8.5	1.5- 1.5
MAX DEPTH**	2	10.7- 11.3	11.0	9.8- 13.1	2	0.2- 1.1	0.6	10.1- 19.8	2	0.0- 0.0	0.0	10.4- 12.2
CONDUCTIVITY (UMHOS)												
0.-1.5 M DEPTH	2	130.- 130.	130.	0.0- 0.0	4	135.- 141.	138.	0.0- 1.5	4	270.- 300.	280.	0.0- 1.5
MAX DEPTH**	2	125.- 125.	125.	9.8- 13.1	2	111.- 116.	114.	10.1- 19.8	2	320.- 330.	325.	10.4- 12.2
PH (STANDARD UNITS)												
0.-1.5 M DEPTH	2	8.1- 8.2	8.1	0.0- 0.0	2	8.7- 8.7	8.7	0.0- 0.0	4	7.1- 7.7	7.3	0.0- 1.5
MAX DEPTH**	2	7.6- 7.9	7.7	9.8- 13.1	2	6.6- 6.6	6.6	10.1- 19.8	2	6.5- 6.5	6.5	10.4- 12.2
TOTAL ALKALINITY (MG/L)												
0.-1.5 M DEPTH	2	26.- 28.	27.	0.0- 0.0	2	32.- 33.	33.	0.0- 0.0	4	30.- 35.	33.	0.0- 1.5
MAX DEPTH**	2	24.- 26.	25.	9.8- 13.1	2	42.- 43.	43.	10.1- 19.8	2	43.- 48.	46.	10.4- 12.2
TOTAL P (MG/L)												
0.-1.5 M DEPTH	2	0.015-0.020	0.017	0.0- 0.0	2	0.019-0.025	0.022	0.0- 0.0	4	0.021-0.038	0.026	0.0- 1.5
MAX DEPTH**	2	0.021-0.023	0.022	9.8- 13.1	2	0.014-0.020	0.017	10.1- 19.8	2	0.028-0.030	0.029	10.4- 12.2
DISSOLVED ORTHO P (MG/L)												
0.-1.5 M DEPTH	2	0.005-0.011	0.008	0.0- 0.0	2	0.007-0.009	0.008	0.0- 0.0	4	0.008-0.009	0.009	0.0- 1.5
MAX DEPTH**	2	0.005-0.010	0.007	9.8- 13.1	2	0.005-0.007	0.006	10.1- 19.8	2	0.012-0.012	0.012	10.4- 12.2
NO2+NO3 (MG/L)												
0.-1.5 M DEPTH	2	0.440-0.480	0.460	0.0- 0.0	2	0.140-0.150	0.145	0.0- 0.0	4	0.030-0.050	0.045	0.0- 1.5
MAX DEPTH**	2	0.460-0.480	0.470	9.8- 13.1	2	0.080-0.120	0.100	10.1- 19.8	2	0.030-0.030	0.030	10.4- 12.2
AMMONIA (MG/L)												
0.-1.5 M DEPTH	2	0.030-0.030	0.030	0.0- 0.0	2	0.060-0.080	0.070	0.0- 0.0	4	0.060-0.060	0.060	0.0- 1.5
MAX DEPTH**	2	0.030-0.040	0.035	9.8- 13.1	2	0.460-0.650	0.555	10.1- 19.8	2	0.920-1.240	1.080	10.4- 12.2
KJELDAHL N (MG/L)												
0.-1.5 M DEPTH	2	0.200-0.200	0.200	0.0- 0.0	2	1.000-1.800	1.400	0.0- 0.0	4	0.700-1.000	0.850	0.0- 1.5
MAX DEPTH**	2	0.200-0.200	0.200	9.8- 13.1	2	0.600-1.200	0.900	10.1- 19.8	2	1.600-2.000	1.800	10.4- 12.2
SECCHI DISC (METERS)												
	2	1.5- 1.5	1.5		2	1.9- 2.3	2.1		2	1.8- 1.8	1.8	

* N = NO. OF SAMPLES
** MAXIMUM DEPTH SAMPLED AT EACH SITE
*** S = NO. OF SITES SAMPLED ON THIS DATE

B. Biological Characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
04/18/73	1. Synedra	13,519
	2. Asterionella	4,953
	3. Melosira	1,869
	4. Flagellates	1,775
	5. Oscillatoria	997
	Other genera	1,184
	Total	24,297
07/22/73	1. Cyclotella	5,711
	2. Flagellates	1,179
	3. Coelosphaerium	471
	4. Tetraedron	340
	5. Rhizosolenia	262
	Other genera	892
	Total	8,855
10/02/73	1. Cyclotella	951
	2. Flagellates	852
	3. Melosira	416
	4. Tetraedron	377
	5. Scenedesmus	159
	Other genera	317
	Total	3,072

2. Chlorophyll *a* -

Sampling Date	Station Number	Chlorophyll *a* (µg/l)
04/18/73	1	19.9
	2	18.7
07/22/73	1	23.6
	2	10.4
10/02/73	1	9.8
	2	9.6

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike(mg/l)	Ortho P Conc.(mg/l)	Inorganic N Conc.(mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.010	0.438	1.3
0.05 P	0.060	0.438	12.1
0.05 P + 1.0 N	0.060	1.438	16.5
1.00 N	0.010	1.438	0.7

2. Discussion--

The control yield of the assay alga, *Selenastrum capricornutum*, indicates that the potential for primary productivity in Spruce Run Reservoir was high at the time of sampling. The lake was phosphorus limited at that time as indicated by the increased growth of the assay alga in response to an addition of orthophosphorus. Spikes with phosphorus and nitrogen simultaneously resulted in a maximum yield. An addition of nitrogen alone did not stimulate the growth beyond the control yield.

The N/P ratio of 82/1 in the spring lake data further indicates phosphorus limitation.

IV. NUTRIENT LOADINGS
(See Appendix D for data)

For the determination of nutrient loadings, the New Jersey National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff months of February and March when two samples were collected. Sampling was begun in July 1973, and was completed in June 1974.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the New Jersey District Office of USGS for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of the USGS computer program for calculating stream loadings. Nutrient loads indicated for tributaries are those measured minus known point source loads, if any.

Nutrient loadings for unsampled "minor tributaries and immediate drainage" ("ZZ" of USGS) were estimated by using the mean annual concentrations in Unnamed Stream at Station C(1), Willoughby Brook at Station D(1), and Black Brook at Station E(1) and mean annual ZZ flow.

The operator of the Union Township School wastewater treatment plant provided monthly effluent samples and corresponding flow data.

A. Waste Sources:

1. Known municipal -

Name	Population Served*	Treatment*	Mean Flow ($m^3/d \times 10^3$)	Receiving Water*
Union Township School	400	Activated Sludge	0.019	Mulhockaway Stream

2. Known industrial - None

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/yr	% of total
a. Tributaries (nonpoint load) -		
A(2) Spruce Run	650	44.7
B(1) Mulhockaway Stream	295	20.3
C(1) Unnamed Stream	50	3.4
D(1) Willoughby Brook	70	4.8
E(1) Black Brook	70	4.8
b. Minor tributaries and immediate drainage (nonpoint load) -	190	13.1
c. Known municipal STP's -		
Union Township School	40	2.7
d. Septic tanks** -	<1	<0.1
e. Known industrial - None		
f. Direct precipitation*** -	90	6.2
Totals	1,455	100.0
2. Output - A(1) Spruce Run	875	
3. Net annual P accumulation -	580	

*Treatment plant questionnaire.
**Estimate based on 1 lakeside residence.
***Estimated (see NES Working Paper No. 175))

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (nonpoint load) -		
A(2) Spruce Run	29,670	36.8
B(1) Mulhockaway Stream	21,935	27.2
C(1) Unnamed Stream	5,820	7.2
D(1) Willoughby Brook	3,230	4.0
E(1) Black Brook	2,975	3.7
b. Minor tributaries and immediate drainage (nonpoint load) -	11,170	13.9
c. Known municipal STP's -		
Union Township School	120	0.2
d. Septic tanks* -	10	<0.1
e. Known industrial - None		
f. Direct precipitation** -	5,635	7.0
Totals	80,565	100.0
2. Output - A(1) Spruce Run	57,815	
3. Net annual N accumulation -	22,750	

*Estimate based on 1 lakeside residence.
**Estimated (see NES Working Paper No. 175).

D. Mean Annual Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km²/yr	kg N/km²/yr
A(2) Spruce Run	16	740
B(1) Mulhockaway Stream	10	717
C(1) Unnamed Stream	7	820
D(1) Willoughby Brook	11	513
E(1) Black Brook	16	661

E. Yearly Loads:

In the following table, the existing phosphorus loadings are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" loading is one at which the receiving water would become eutrophic or remain eutrophic; his "permissible" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic loading would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Yearly Phosphorus Loading (g/m²/yr)
Estimated loading for Spruce Run Reservoir	0.28
Vollenweider's "dangerous" or eutrophic loading	0.62
Vollenweider's "permissible" or oligotrophic loading	0.31

V. LITERATURE REVIEWED

U.S. Environmental Protection Agency. 1975. National Eutrophication Survey Methods 1973-1976. Working Paper No. 175. Environmental Monitoring and Support Laboratory, Las Vegas, Nevada and Corvallis Environmental Research Laboratory, Corvallis, Oregon.

Vollenweider, R. A., and P. J. Dillon, 1974. The application of the phosphorus loading concept to eutrophication research. Natl. Res. Council of Canada Publ. No. 13690, Canada Centre for Inland Waters, Burlington, Ontario.

VI. APPENDICES

APPENDIX A

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX B

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR NEW JERSEY 06/04/76

LAKE CODE 3420 SPRUCE RUN RESERVOIR

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 107.0

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
3420A1	107.0	0.74	1.22	1.76	2.24	1.87	2.01	1.95	1.59	2.44	2.04	0.59	0.88	1.61
3420A2	40.1	0.62	0.74	1.19	0.99	0.68	0.34	0.34	0.34	0.27	0.28	0.48	0.59	0.57
3420B1	30.6	0.45	0.54	0.85	0.74	0.48	0.27	0.27	0.25	0.21	0.21	0.34	0.42	0.42
3420C1	7.1	0.119	0.139	0.210	0.181	0.122	0.074	0.071	0.068	0.057	0.057	0.093	0.110	0.108
3420D1	6.3	0.099	0.116	0.187	0.156	0.108	0.054	0.054	0.054	0.042	0.042	0.071	0.093	0.090
3420E1	4.5	0.074	0.088	0.130	0.113	0.076	0.045	0.045	0.042	0.037	0.037	0.057	0.068	0.068
3420ZZ	18.3	0.28	0.34	0.54	0.45	0.31	0.16	0.16	0.16	0.12	0.13	0.22	0.27	0.26

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 107.0
SUM OF SUB-DRAINAGE AREAS = 107.0

TOTAL FLOW IN = 18.23
TOTAL FLOW OUT = 19.31

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3420A1	7	73	1.954	21	2.435	22	2.492	23	1.642
	8	73	1.642	16	2.180				
	9	73	1.303	22	1.444				
	10	73	1.218	13	0.963				
	11	73	0.595	10	0.481				
	12	73	5.550	15	3.426				
	1	74	3.540	26	4.078				
	2	74	1.812	9	1.246	24	1.303		
	3	74	2.464	9	1.472	23	5.890		
	4	74	3.653	20	2.945				
	5	74	2.067	11	3.115				
	6	74	1.048	8	0.680				
3420A2	7	73	0.821	21	5.154	23	0.850		
	8	73	0.765	16	0.680				
	9	73	0.269	22	0.210				
	10	73	0.481	13	0.221				
	11	73	0.481	10	0.396				
	12	73	1.982	15	1.472				
	1	74	1.331	26	1.331				
	2	74	0.850	9	0.736	24	0.906		
	3	74	1.104	9	1.246	23	1.416		
	4	74	1.614	20	1.614				
	5	74	0.878	11	1.104				
	6	74	0.566	8	0.396				

TRIBUTARY FLOW INFORMATION FOR NEW JERSEY 06/04/76

LAKE CODE 3420 SPRUCE RUN RESERVOIR

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3420B1	7	73	0.623	21	3.908	23	0.623		
	8	73	0.538	16	0.510				
	9	73	0.207	22	0.164				
	10	73	3.200	13	0.173				
	11	73	3.200	10	0.311				
	12	73	1.359	15	1.019				
	1	74	0.934	26	0.934				
	2	74	0.623	9	0.538	24	0.651		
	3	74	0.793	9	0.906	23	0.991		
	4	74	1.161	20	1.133				
	5	74	0.651	11	0.793				
	6	74	0.425	8	0.311				
3420C1	7	73	0.153	21	0.906	23	0.159		
	8	73	0.142	16	0.130				
	9	73	0.057	22	0.045				
	10	73	0.093	13	0.048				
	11	73	0.093	10	0.082				
	12	73	0.340	15	0.255				
	1	74	0.235	26	0.232				
	2	74	0.159	9	0.136	24	0.164		
	3	74	0.198	9	0.221	23	0.246		
	4	74	0.288	20	0.278				
	5	74	0.164	11	0.198				
	6	74	0.110	8	0.079				
3420D1	7	73	0.125	21	0.821	23	0.133		
	8	73	0.122	16	0.108				
	9	73	0.042	22	0.034				
	10	73	0.076	13	0.034				
	11	73	0.076	10	0.062				
	12	73	0.311	15	0.232				
	1	74	0.210	26	0.210				
	2	74	0.133	9	0.116	24	0.144		
	3	74	0.176	9	0.195	23	0.224		
	4	74	0.255	20	0.255				
	5	74	0.139	11	0.176				
	6	74	0.091	8	0.062				
3420E1	7	73	0.096	21	0.566	23	0.0		
	8	73	0.088	16	0.082				
	9	73	0.037	22	0.028				
	10	73	0.059	13	0.031				
	11	73	0.059	10	0.051				
	12	73	0.212	15	0.159				
	1	74	0.147	26	0.144				
	2	74	0.099	9	0.085	24	0.102		
	3	74	0.125	9	0.139	23	0.156		
	4	74	0.176	20	0.173				
	5	74	0.102	11	0.125				
	6	74	0.068	8	0.051				

TRIBUTARY FLOW INFORMATION FOR NEW JERSEY 06/04/76

LAKE CODE 3420 SPRUCE RUN RESERVOIR

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3420ZZ	7	73	0.368	21	2.350	23	0.396		
	8	73	0.340	16	0.311				
	9	73	0.122	22	0.096				
	10	73	0.221	13	0.102				
	11	73	0.221	10	0.181				
	12	73	0.906	15	0.680				
	1	74	0.595	26	0.595				
	2	74	0.396	9	0.340	24	0.425		
	3	74	0.510	9	0.566	23	0.651		
	4	74	0.736	20	0.736				
	5	74	0.396	11	0.510				
	6	74	0.258	8	0.181				

APPENDIX C

PHYSICAL AND CHEMICAL DATA

STORET RETRIEVAL DATE 76/06/04

342001
40 38 48.0 074 55 02.0 3
SPRUCE RUN RESERVOIR
34019 NEW JERSEY

013392

11EPALES 2111202
0047 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/04/18	09	25 0000	10.8		60	130	8.10	26	0.030	0.200K	0.440	0.011
	09	25 0006	10.7	12.6		130	8.20	26	0.020	0.200	0.430	0.006
	09	25 0015	10.5	11.9		130	8.10	26	0.020	0.200K	0.440	0.004
	09	25 0022	9.8	11.6		130	8.00	26	0.020	0.200K	0.440	0.005
	09	25 0030	9.1	11.1		130	7.90	26	0.030	0.200K	0.460	0.005
	09	25 0043	8.9	10.7		125	7.60	26	0.040	0.200K	0.460	0.010
73/07/22	16	20 0000	26.2	9.0	92	138	8.70	33	0.060	1.800	0.150	0.009
	16	20 0005	25.8			135						
	16	20 0010	25.0			132						
	16	20 0016	22.0	5.3		120	6.50	31	0.070	0.800	0.320	0.007
	16	20 0020	19.0			113						
	16	20 0025	16.2			108						
	16	20 0030	14.9			108						
	16	20 0040	13.5	0.3		106	6.40	36	0.210	0.700	0.300	0.007
	16	20 0050	12.2			107						
	16	20 0060	11.8			111						
	16	20 0065	11.5	0.2		111	6.60	43	0.650	1.200	0.080	0.007
73/10/02	09	25 0000	19.9		72	300	7.70	30	0.060	0.900	0.040	0.009
	09	25 0005	19.8	8.2		280	7.20	31	0.060	0.700	0.030	0.006
	09	25 0015	19.7	8.0		270	6.90	30	0.070	0.700	0.030	0.008
	09	25 0033	14.5	0.2		310	6.60	43	0.780	1.400	0.040	0.009
	09	25 0040	12.9	0.0		330	6.50	48	1.240	2.000	0.030	0.012

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/06/04

342001
40 38 48.0 074 55 02.0 3
SPRUCE RUN RESERVOIR
34019 NEW JERSEY

013392

11EPALES 2111202
0047 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/04/18	09 25	0000	0.015	19.9
	09 25	0006	0.013	
	09 25	0015	0.015	
	09 25	0022	0.018	
	09 25	0030	0.018	
	09 25	0043	0.023	
73/07/22	16 20	0000	0.025	23.6
	16 20	0016	0.027	
	16 20	0040	0.012	
	16 20	0065	0.014	
73/10/02	09 25	0000	0.025	9.8
	09 25	0005	0.021	
	09 25	0015	0.020	
	09 25	0033	0.022	
	09 25	0040	0.030	

STORET RETRIEVAL DATE 76/06/04

342002
40 39 41.0 074 55 21.0 3
SPRUCE RUN RESERVOIR
34019 NEW JERSEY

013392

11EPALES 2111202
0036 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/04/17	10 05 0000		11.9		60	130	8.20	28	0.030	0.200	0.480	0.005
	10 05 0006		12.0	12.5		130	8.30	28	0.030	0.200K	0.480	0.005
	10 05 0015		10.9	12.5		125	8.20	26	0.020	0.500	0.460	0.005
	10 05 0022		10.3	11.9		130	8.10	25	0.020	0.200K	0.470	0.004
	10 05 0032		9.5	11.3		125	7.90	24	0.030	0.200K	0.480	0.005
73/07/22	17 00 0000		27.3	9.1	74	141	8.70	32	0.080	1.000	0.140	0.007
	17 00 0005		26.8			138						
	17 00 0010		25.3			136						
	17 00 0015		22.6	6.1		129	6.90	31	0.030	0.080	0.400	0.007
	17 00 0020		17.6	8.9		115	6.50	34	0.160	0.300	0.300	0.006
	17 00 0025		15.4			113						
	17 00 0030		14.1			115						
	17 00 0033		13.6	1.1		116	6.60	42	0.460	0.680	0.120	0.005
73/10/02	09 55 0000		20.3		70	280	7.40	35	0.060	1.000	0.050	0.009
	09 55 0005		20.2	8.8		270	7.10	35	0.060	0.880	0.050	0.009
	09 55 0015		19.8	7.6		280	6.90	35	0.090	0.780	0.060	0.008
	09 55 0025		18.2	1.4		300	6.50	42	0.420	0.900	0.040	0.008
	09 55 0034		14.5	0.0		320	6.50	43	0.920	1.600	0.030	0.012

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/04/17	10 05 0000		0.020	18.7
	10 05 0006		0.019	
	10 05 0015		0.018	
	10 05 0022		0.018	
	10 05 0032		0.021	
73/07/22	17 00 0000		0.019	10.4
	17 00 0015		0.027	
	17 00 0020		0.019	
	17 00 0033		0.020	
73/10/02	09 55 0000		0.027	9.6
	09 55 0005		0.038	
	09 55 0015		0.023	
	09 55 0025		0.029	
	09 55 0034		0.028	

K VALUE KNOWN TO BE
LESS THAN INDICATED

APPENDIX D

TRIBUTARY AND WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 76/06/04

3420A1
40 38 44.0 074 54 52.0 4
SPRUCE RUN
34 7.5 HIGH BRIDGE
O/SPRUCE RUN RESERVOIR 013392
S END GAGE WEIR 0.2 MI W OF ST HWY 31
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/07/22	10 30		0.550	1.540	0.610	0.018	0.020
73/08/16	21 00		0.086	0.670	0.252	0.005K	0.015
73/09/22	15 10		0.093	0.440	0.092	0.005K	0.015
73/10/13	11 45		0.088	0.420	0.048	0.006	0.020
73/11/10	10 55		0.231	0.575	0.063		0.005K
73/12/15	11 40		0.200	0.500	0.094	0.008	0.020
74/01/26	14 40		0.510	0.200	0.040	0.005K	0.005K
74/02/09	11 00		0.520	0.200	0.020	0.005	0.013
74/02/24	15 55		0.510	0.700	0.010	0.005K	0.025
74/03/09	16 20		0.460	0.300	0.015	0.005	0.030
74/03/23	14 00		0.450	1.200	0.035	0.005K	0.025
74/04/20	13 15		0.440	1.500	0.060	0.005	0.010
74/05/11	14 00		0.315	1.000	0.055	0.015	0.020
74/06/09	11 00		0.252	1.700	0.095	0.010	0.015

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/06/04

3420A2
40 40 27.0 074 55 02.0 4
SPRUCE RUN
34 7.5 HIGH BRIDGE
I/SPRUCE RUN RESERVOIR 013392
2NDRY RD BRDG 0.1 MI W OF ST HWY 31
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/07/21	15 55		0.710	1.760	0.520	0.033	
73/08/16	20 35		0.650	0.220	0.150	0.023	0.045
73/09/22	14 30		0.800	0.210	0.029	0.038	0.045
73/10/13	10 30		0.399	0.260	0.017	0.030	0.040
73/11/10	10 30		0.860	0.100K	0.021	0.022	0.055
73/12/15	10 30		0.850	0.400	0.028	0.012	0.035
74/01/26	11 55		1.180	2.100	0.100		0.010
74/02/09	11 30		1.340	0.300	0.025	0.020	0.020
74/02/24	14 35		1.060	0.700	0.020	0.015	0.045
74/03/09	15 00		0.930	0.300	0.015	0.010	0.040
74/03/23	11 40		1.010	0.500	0.030	0.015	0.025
74/04/20	11 55		0.740	2.200	0.065	0.010	0.020
74/05/11	11 15		0.560	0.900	0.080	0.010	0.025
74/06/08	13 13		0.910	0.200	0.045	0.041	0.045

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/06/04

3420B1
40 38 50.0 074 58 10.0 4
MULHOCKWAY CREEK
34 7.5 HIGH BRIDGE
T/SPRUCE RUN RESERVOIR 013392
CO HWY 26 BRDG 0.8 MI N OF PERRYVILLE
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/07/21	15 15		0.570	1.800	0.770	0.033	
73/08/16	22 00		0.890	0.830	0.360	0.020	0.050
73/09/22	13 45		1.160	0.230	0.037	0.017	0.040
73/10/13	14 00		0.920	0.180	0.008	0.011	0.011
73/11/10	09 45		1.140	0.100K	0.014	0.015	0.020
73/12/15	09 30		1.010	0.200	0.020	0.008	0.015
74/01/26	11 00		1.180	0.800	0.040	0.015	0.015
74/02/09	15 00		1.500	0.300	0.015	0.005	0.005
74/02/24	13 45		1.200	0.600	0.010	0.010	0.030
74/03/09	14 00		0.920	0.400	0.017	0.007	0.030
74/03/23	10 45		1.000	0.300	0.020	0.010	0.020
74/04/20	11 00		0.820	0.800	0.040	0.010	
74/05/11	10 20		0.630	0.800	0.090	0.010	0.020
74/06/08	11 15		1.000	0.300	0.030	0.020	0.025

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/06/04

3420C1
40 39 05.0 074 58 13.0 4
UNNAMED STREAM
34 7.5 HIGH BRIDGE
T/SPRUCE RUN RESERVOIR 013392
2NDRY RD BRDG 1.1 MI N OF PERRYVILLE
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/07/23	15 30		0.430	2.800	1.470	0.017	
73/08/16	20 10		0.500	2.520	0.540	0.011	0.020
73/09/22	14 05		0.710	1.380	0.600	0.011	0.020
73/10/13	10 15		0.450	0.210	0.010	0.008	0.008
73/11/10	09 55		0.610	0.100K	0.020	0.010	0.010
73/12/15	09 50		0.650	0.100	0.020	0.005K	0.010
74/01/26	11 20		0.756	2.200	0.070	0.010	0.010
74/02/09	13 30		0.930	0.100K	0.015	0.005	0.005
74/02/24	13 55		0.810	0.900	0.030	0.005	0.015
74/03/09	14 15		0.650	0.700	0.025	0.005	0.025
74/03/23	11 05		0.630	0.600	0.030	0.005	0.017
74/04/20	11 15		0.520	1.000	0.025	0.010	0.125
74/05/11	10 35		0.450	0.300	0.025	0.010	0.015
74/06/08	11 30		0.730	1.200	0.045	0.010	0.010

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/06/04

342001
40 40 18.0 074 54 56.0 4
WILLOUGHBY BROOK
34 7.5 HIGH BRIDGE
T/SPRUCE RUN RESERVOIR 013392
NJ HWY 31 BRDG 1 MI N OF MARIANNES CORNE
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/07/23	16 15		0.086	2.360		0.021	
73/08/16	20 45		0.260	1.900	0.950	0.022	0.045
73/09/22	14 40		0.310	0.240	0.042	0.012	0.025
73/10/13	11 00		0.056	0.270	0.017	0.006	0.006
73/11/10	10 40		0.300	0.350	0.024	0.010	0.010
73/12/15	10 40		0.570	0.200	0.016	0.005K	0.005
74/01/26	13 10		0.630	0.900	0.030	0.005	0.005
74/02/09	09 30		0.750	0.100	0.010	0.005K	0.005
74/02/24	14 55		0.460	0.600	0.020	0.005K	0.015
74/03/09	15 15		0.460	0.300	0.030	0.005	0.030
74/03/23	13 10		0.570	0.500	0.015	0.005	0.015
74/04/20	12 30		0.276	0.300	0.010	0.005K	0.005K
74/05/11	11 40		0.260	1.000	0.020	0.050	0.130
74/06/08	13 40		0.460	0.900	0.030	0.011	0.020

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/06/04

3420E1
40 39 34.0 074 56 52.0 4
BLACK BROOK
34 7.5 HIGH BRIDGE
T/SPRUCE RUN RESERVOIR 013392
2NDRY RD BRDG 1.3 MI ENE OF VAN SYCKEL
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/07/21	15 40		0.780	3.300	0.180	0.066	
73/08/16	20 20		0.270	1.000	0.290	0.025	0.055
73/09/22	14 20		0.600	1.050	0.670	0.017	0.025
73/10/13	10 20		0.280	0.540	0.021	0.014	0.015
73/11/10	10 15		0.350	0.500	0.063	0.014	0.035
74/01/26	11 35		0.480	0.100	0.015	0.005	0.015
74/02/09	12 00		0.600	0.100K	0.015	0.010	0.020
74/02/24	14 15		0.590	0.700	0.035	0.015	0.025
74/03/09	14 35		0.460	0.500	0.030	0.010	0.040
74/03/23	11 15		0.350	1.000	0.055	0.005	0.045
74/04/20	11 25		0.252	1.700	0.055	0.005	0.015
74/05/11	10 55		0.200	0.900	0.035	0.030	0.040
74/06/08	11 55		0.450	0.500	0.020	0.015	0.055

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/06/04

34208A AS34208A P000071
40 37 50.0 074 38 13.0 4
UNION TOWNSHIP SCHOOL
34 7.5 HIGH BRIDGE
T/SPRUCE RUN RESERVOIR 013391
MULHOCOWAY STREAM
11EPALES 2141204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/12/04	10 00		30.000	1.850	0.890	6.900	7.150	0.005	0.005
74/01/16	10 00		6.300	16.000	1.360	2.100	7.350	0.005	0.005
74/02/20	10 00		3.200	11.000		3.520	3.700	0.005	0.005
74/03/14	10 00		3.200	13.000	0.180		6.600	0.005	0.005
74/04/10	09 30		16.000	3.900	1.950	4.600	4.900	0.005	0.005
74/05/14	10 30		8.000	1.000K	0.150	5.900	5.900	0.005	0.005
74/07/17	09 00		45.500	1.000K	0.175	3.100	12.600		
74/09/17	09 15		23.000	0.600	0.025K	7.500	7.600	0.005	0.005
74/10/17	10 00		7.800	1.000K	0.045	4.040	4.040	0.005	0.005
74/11/14	09 30		7.800	1.000K	0.050K	5.150	5.150	0.005	0.005
74/12/11	09 45		16.800	1.000K	0.110	7.500	7.500	0.005	0.005
75/01/22	09 30		0.400	3.000	0.080K	0.190	9.500	0.005	0.005
75/02/18	08 00		3.680	1.200	0.110	1.550	1.600	0.005	0.005

K VALUE KNOWN TO BE
LESS THAN INDICATED

APPENDIX E

PARAMETRIC RANKINGS OF LAKES SAMPLED BY NES IN 1973

STATE OF NEW JERSEY

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
3402	BUDD LAKE	0.082	0.205	474.000	48.500	7.400	0.012
3403	GREENWOOD LAKE	0.021	0.100	414.250	11.920	14.800	0.007
3406	ORADELL RESERVOIR	0.055	0.990	462.500	22.267	13.600	0.008
3409	PINECLIFF LAKE	0.070	0.175	465.500	38.960	11.000	0.011
3410	POMPTON LAKES	0.071	0.795	463.167	23.033	11.800	0.029
3412	DUHERNAL LAKE	0.082	1.420	466.667	6.800	8.600	0.010
3413	FARRINGTON LAKE	0.055	0.770	462.000	8.283	14.400	0.012
3415	LAKE HOPATCONG	0.022	0.120	416.333	13.627	14.900	0.007
3417	LAKE MUSCONETCONG	0.036	0.140	436.000	11.067	6.000	0.010
3419	PAULINS KILL LAKE	0.133	0.950	460.500	7.017	9.000	0.065
3420	SPRUCE RUN RESERVOIR	0.020	0.470	428.667	15.333	15.000	0.007
3422	UNION LAKE	0.063	1.150	463.200	22.080	12.800	0.018
3423	WANAQUE RESERVOIR	0.014	0.120	355.333	7.111	14.800	0.005

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
3402	BUDD LAKE	12 (1)	58 (7)	0 (0)	0 (0)	92 (11)	29 (3)	191
3403	GREENWOOD LAKE	83 (10)	100 (12)	92 (11)	58 (7)	21 (2)	83 (9)	437
3406	ORADELL RESERVOIR	54 (6)	17 (2)	42 (5)	25 (3)	42 (5)	67 (8)	247
3409	PINECLIFF LAKE	33 (4)	67 (8)	17 (2)	8 (1)	67 (8)	42 (5)	234
3410	POMPTON LAKES	25 (3)	33 (4)	33 (4)	17 (2)	58 (7)	8 (1)	174
3412	DUHERNAL LAKE	12 (1)	0 (0)	8 (1)	100 (12)	83 (10)	58 (7)	261
3413	FARRINGTON LAKE	54 (6)	42 (5)	50 (6)	75 (9)	33 (4)	29 (3)	283
3415	LAKE HOPATCONG	75 (9)	87 (10)	83 (10)	50 (6)	8 (1)	83 (9)	386
3417	LAKE MUSCONETCONG	67 (8)	75 (9)	67 (8)	67 (8)	100 (12)	50 (6)	426
3419	PAULINS KILL LAKE	0 (0)	25 (3)	58 (7)	92 (11)	75 (9)	0 (0)	250
3420	SPRUCE RUN RESERVOIR	92 (11)	50 (6)	75 (9)	42 (5)	0 (0)	83 (9)	342
3422	UNION LAKE	42 (5)	8 (1)	25 (3)	33 (4)	50 (6)	17 (2)	175
3423	WANAQUE RESERVOIR	100 (12)	87 (10)	100 (12)	83 (10)	21 (2)	100 (12)	491

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	3423	WANAQUE RESERVOIR	491
2	3403	GREENWOOD LAKE	437
3	3417	LAKE MUSCONETCONG	426
4	3415	LAKE HOPATCONG	386
5	3420	SPRUCE RUN RESERVOIR	342
6	3413	FARRINGTON LAKE	283
7	3412	DUHERNAL LAKE	261
8	3419	PAULINS KILL LAKE	250
9	3406	ORADELL RESERVOIR	247
10	3409	PINECLIFF LAKE	234
11	3402	BUDD LAKE	191
12	3422	UNION LAKE	175
13	3410	POMPTON LAKES	174